CLAIMS

What is claimed is:

1. A method for calculating an approximate cost of multi-protocol label switching (MPLS)-based virtual private network (VPN) services, comprising:

computing a greatest lower bound for the bandwidth used in an MPLS-based VPN;

computing a least upper bound for the bandwidth used in an MPLS-based VPN; and

combining the upper bound and the lower bound to produce an estimate for the cost of the bandwidth.

2. The method of claim 1, wherein the step of computing a least upper bound includes a cut constraint.

3. A computer program method for calculating an approximate cost of multi-protocol label switching (MPLS)-based virtual private network (VPN) services, comprising:

computing a greatest lower bound for the bandwidth used in an MPLS-based VPN;

computing a least upper bound for the bandwidth used in an MPLS-based VPN; and

combining the upper bound and the lower bound to produce an estimate for the cost of the bandwidth.

4. The computer program method of claim 3, wherein the step of computing a least upper bound includes a cut constraint.

5. A method for calculating an approximate cost of multi-protocol label switching (MPLS) based virtual private network (VPN) services, comprising:

computing a greatest lower bound for the bandwidth used in an MPLS-based VPN, comprising the steps of:

(a) Creating an auxiliary graph of Start and Finish nodes and one node for each node in the VPN that is saturated with inbound flow;

(b) Creating a directed edge between the nodes representing a least cost of adding flow from a node which has flow left to place to a node which has capacity to receive the flow;

(c) Calculating a shortest path algorithm to find the path from Start and Finish nodes giving an optimal way of serving the previously unserved unit of flow.

(d) Outputting L as a greatest lower bound for the bandwidth used;

computing a least upper bound for the bandwidth used in an MPLS-based VPN, comprising the steps of:

(e) Creating an auxiliary graph consisting of the nodes Start, Finish, and one node for each node in the VPN that is saturated with inbound flow;

(f) Creating a directed edge between the nodes representing a greatest cost of adding flow from a node which has flow left to place to a node which has capacity to receive the flow;

(g) Calculating a longest path algorithm to find the path from Start to Finish, giving a worst way of serving the previously unserved unit of flow;

(h) Outputting U as a least upper bound for the bandwidth used;

combining the upper bound and the lower bound to produce an estimate for the cost of the bandwidth, comprising the step of:

(i) setting a $Total\_cost \approx \alpha \times U + (1 - \alpha) \times L$

where α is a measure of risk of losing money by carrying a given customer's VPN.